PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-146092

(43)Date of publication of application : 06.06.1997

(51)Int.Cl. G02F 1/1335
F21V 8/00
G09F 9/00
G09F 9/00

(21)Application number : 07-304518

(22)Date of filing : 22.11.1995

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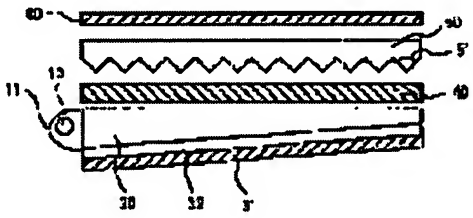
(54) ILLUMINATION DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an illumination device for which an easily producible and inexpensive polarizing plate separator consisting of flat multilayered films of dielectric substances is used and which is low in absorption loss and has a high degree of polarization and high uniformity of light by forming a light transmission body so that its thickness is smaller as going further from a light source, and providing its exit side with a polarized light separating means and providing the surface of the polarized light separating means with an optical path changing means.



SOLUTION: The light transmission body is so formed as to be smaller in its thickness as going further from the light source. The light transmission body has the polarized light separating mans on its exit side and has the optical path changing means for emitting the light in the direction nearly normal to the exit surface of the light transmission body by changing the optical path on the polarized light separating means. Namely, the polarized light separating means 40 consisting of the multilayered films of the dielectric substances is arranged on the wedge type light transmission body 30. Further, a prism array sheet is arranged as the optical path changing means 50 thereon. The vertex 51 thereof is

specified to 65° and a prescribed polymer film is used thereon as a light scattering body 60°.

LEGAL STATUS

[Date of request for examination]	03.02.2000
[Date of sending the examiner's decision of rejection]	02.10.2001
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	2001-19343
[Date of requesting appeal against examiner's decision of rejection]	30.10.2001
[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The lighting system characterized by having been the lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, having been formed so that it might become thin as the thickness of said transparent material separated from said light source, and for the directivity of the outgoing radiation light from a transparent material having been large, and equipping the outgoing radiation side of this transparent material with an optical-path conversion means on a polarization separation means and this polarization separation means.
[Claim 2] The lighting system characterized by being the lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, having equipped the outgoing radiation side of this wedge-action-die transparent material with the polarization separation means by the wedge-action-die transparent material which becomes thin as said transparent material separates from the light source, and having an optical-path conversion means on this polarization separation means.
[Claim 3] The lighting system which is a lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, equips the outgoing radiation side of this wedge-action-die transparent material with a polarization separation means by the wedge-action-die transparent material which becomes thin as said transparent material separates from the light source, and is characterized by having for light the optical-path conversion means of the outgoing radiation side of a transparent material which carries out outgoing radiation in the direction of a normal mostly on this polarization separation means.
[Claim 4] The lighting system which equips the outgoing-radiation side of this wedge-action-die transparent material with a polarization separation means, and is characterized for light on this polarization separation means by the thing of the outgoing-radiation side of a transparent material for which it had the maximum of optical reinforcement in the direction of a normal mostly, and the light of dispersion nature equipped with conversion and the optical-path conversion means which carries out outgoing radiation by the wedge-action-die transparent material which is the lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, and becomes thin as said transparent material separates from the light source.
[Claim 5] The lighting system carry out having had the light-scattering object which is the lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, equips the outgoing-radiation side of this wedge-action-die transparent material with a polarization separation means, has for light the optical-path conversion means of the outgoing-radiation side of a transparent material which carries out outgoing radiation in the direction of a normal mostly on this polarization separation means by the wedge-action-die transparent material which becomes thin as said transparent material separates from the light source, and has polarization ability and dispersion nature on this optical-path conversion means as the description.

[Claim 6] The lighting system according to claim 5 said whose optical-path conversion means is the hologram which has dispersion nature and directivity.
[Claim 7] The lighting system according to claim 1 to 6 with which said polarization separation means consists of flat multilayers from which a refractive index differs.
[Claim 8] said conductor -- the lighting system according to claim 1 to 7 with which the transparence medium of a low refractive index is arranged by the upper polarization separation means or the upper optical-path conversion means rather than these refractive indexes.
[Claim 9] It is the liquid crystal display which carries out image display by having the polarizing plate of a pair and controlling the polarization condition of light. It is formed so that it may become thin as the light source and this light source are equipped with the transparent material by which contiguity arrangement was carried out and the thickness of said transparent material separates from said light source. And the liquid crystal display characterized by having arranged the lighting system with which the directivity of the outgoing radiation light from a transparent material was large with the lighting system, and equipped the outgoing radiation side of this transparent material with the optical-path conversion means on the polarization separation means and this polarization separation means at the tooth back of a liquid crystal display component.
[Claim 10] The liquid crystal display which carries out [having arranged the lighting system which is ********** which carries out image display by having the polarizing plate of a pair and controlling the polarization condition of light, equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, equipped the outgoing-radiation side of this wedge-action-die transparent material with the polarization separation means, and was equipped with an optical-path conversion means on this polarization separation means by the wedge-action-die transparent material which becomes thin as said transparent material separates from the light source at the tooth back of a liquid crystal display component, and] as the description.
[Claim 11] By the wedge-action-die transparent material which becomes thin as it is ********** which carries out image display by having the polarizing plate of a pair and controlling the polarization condition of light, the light source and this light source are equipped with the transparent material by which contiguity arrangement was carried out and this transparent material separates from the light source The liquid crystal display which equips the outgoing radiation side of this wedge-action-die transparent material with a polarization separation means, and is characterized by having arranged the lighting system equipped with the optical-path conversion means of the outgoing radiation side of a transparent material which carries out outgoing radiation in the direction of a normal mostly for light at the tooth back of a liquid crystal display component on this polarization separation means.
[Claim 12] By the wedge-action-die transparent material which is the lighting system which equipped the light source and this light source with the transparent material by which contiguity arrangement was carried out, and becomes thin as said transparent material separates from the light source The liquid crystal display characterized by having equipped the outgoing radiation side of this wedge-action-die transparent material with the polarization separation means, and having arranged for light the lighting system of the outgoing radiation side of a transparent material which had the maximum of optical reinforcement in the direction of a normal mostly, and equipped the light of dispersion nature with conversion and the optical-path conversion means which carries out outgoing radiation at the tooth back of a liquid crystal display component on this polarization separation means.
[Claim 13] The liquid crystal display according to claim 8 to 12 with which the polarization separation means of said lighting system consists of flat multilayers from which a refractive index differs.
[Claim 14] The liquid crystal display according to claim 8 to 13 with which the light-scattering layer is arranged at the front-face side of said liquid crystal display component.
[Claim 15] The liquid crystal display according to claim 8 to 14 with which the light-scattering layer which has light-scattering nature between the polarizing plates of the pair of said liquid crystal display component is arranged.
[Claim 16] the conductor of said lighting system -- the liquid crystal display according to claim 8 to 15 with which the transparence medium of a low refractive index is arranged by the upper polarization

separation means or the upper optical-path conversion means rather than these refractive indexes.
[Claim 17] The liquid crystal display according to claim 8 to 16 with which the lighting system constituted so that the average polarization shaft of the outgoing radiation light of said lighting system and the polarization shaft of the optical incidence side polarizing plate of a liquid crystal display component might be mostly in agreement is arranged at the tooth back of a liquid crystal display component.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the plane lighting system which is used for a liquid crystal television, the liquid crystal display for computers, etc. and which modulates the polarization condition of linearly polarized light incident light, and relates to the plane lighting system which carried out polarization control especially, and the direct viewing type liquid crystal display using it.
[0002]
[Description of the Prior Art] In recent years, the technical progress of a liquid crystal display, especially a color liquid crystal display is remarkable, and the display of the display quality which is not inferior to CRT came to be seen. Furthermore, voice as a display is not made without a back light (lighting system) with the spread of note type personal computers, but a back light is an indispensable device in a direct viewing type color liquid crystal display.
[0003] such a color liquid crystal display is divided roughly, and has two methods of TN (the twist -- nematic) liquid crystal display by the active-matrix drive using TFT (thin film transistor), and the STN (super twisted nematic) liquid crystal display by multiplexer drive. All arrange a polarizing plate on both sides of a component which held the liquid crystal layer with the glass substrate, and display by modulating the polarization condition of linearly polarized light incident light.
[0004] Although the intensity level required of these back lights varies with the application, in a color note type personal computer, a thin shape, a light weight, and a low power are important technical problems besides brightness especially.
[0005] since [however,] the outgoing radiation light from the back light arranged at the rear face of a liquid crystal display component did not polarize conventionally -- TN mold and a STN mold -- more than one half of incident light will be absorbed with the polarizing plate arranged at the optical incidence side of a display device, in [any] a liquid crystal display component, it is low, and it serves as a dark display. In order to make this bright, when the brightness of a back light was increased, there was a problem which says that power consumption will increase.
[0006]
[Problem(s) to be Solved by the Invention] The lighting system with which a **** optical deflection means by which outgoing radiation light becomes a right angle mostly to a field top transparent material front face at the optical outgoing radiation side side of a field top transparent material is established, and a cross section arranges the polarization separation means which carried out the laminating of the polarization detached core, and carries out outgoing radiation of the polarization to the array part of a triangle-like pillar-shaped prism array on it further like JP,6-265892,A in order to solve said technical problem is proposed.
[0007] However, in order to attain the highly efficient polarization lighting system which has high degree of polarization, high parallelism is required of the incident light to a polarization detached core. Then, in order to solve such a problem, the lighting system to which a thin light guide pipe is made to adjoin, and it is efficient and outgoing radiation of the light of the degree of Takahira line is carried out

according to micro prism structure is proposed by JP,6-202107,A. However, it is not easy for a demand of thickness precision to carry out the laminating of the severe dielectric multilayers on the prism side of detailed irregularity, and it will become high also from on cost.
[0008] Furthermore, it is very difficult to attain the high parallelism of light source light, and the homogeneity within a field to coincidence, and especially the thing about the homogeneity within such a field is not found until now.
[0009] The purpose of this invention consists of flat dielectric multilayers, it is easy to produce, using the polarization separation means of low cost, there is little absorption-of-light loss, and it is high degree of polarization, and it is to offer a lighting system with the high homogeneity of light.
[0010] Other purposes of this invention are to offer the liquid crystal display which used the above-mentioned lighting system.
[0011]
[Means for Solving the Problem] The summary of this invention which attains the above-mentioned purpose is as follows.
[0012] It is the lighting system which becomes the light source and this light source from the transparent material by which contiguity arrangement was carried out, and it is formed so that the thickness may become thin, as said transparent material separates from the light source, the outgoing radiation side of said transparent material is equipped with a polarization separation means, and an optical path is changed on this polarization separation means, and it is in the lighting system which has the optical-path conversion means of the outgoing radiation side of a transparent material which carries out outgoing radiation in the direction of a normal mostly.
[0013] Moreover, it is shown in the liquid crystal display which has arranged said lighting system at the tooth back of a liquid crystal display component so that the average polarization shaft of the outgoing radiation light of the above-mentioned lighting system and the polarization shaft of the polarizing plate by the side of the optical incidence in a liquid crystal display component may be mostly in agreement.
[0014]
[Embodiment of the Invention] In the above, the transparent material formed so that the thickness might become thin is called a wedge-action-die transparent material as it separates from the light source. Directivity is strong, outgoing radiation of the outgoing radiation light from this wedge-action-die transparent material is carried out in the direction of about 70 degrees to the direction of a normal of the outgoing radiation side of a transparent material, they is **ten or less half-value width (include-angle range where optical reinforcement becomes one half of maximums), and its parallelism is quite high.
[0015] Although the parallelism of the light source is required when using the polarization separation means which consists of dielectric multilayers, the outgoing radiation light from this wedge-action-die transparent material becomes what has quite high parallelism.
[0016] The homogeneity of the light within a field can be maintained from enlarging dot area and forming a white ink dot in it as it separates at the rear face of said transparent material from a lamp.
[0017] Moreover, only P polarization is penetrated as a polarization separation means among the outgoing radiation light which is not polarized from said transparent material, and it is formed so that S polarization may be reflected. Here, S polarization is polarization perpendicular to plane of incidence (flat surface which an incident ray and the incident normal stood to the interface make), and P polarization is polarization parallel to the above-mentioned plane of incidence.
[0018] They are the dielectric multilayers which carried out the multilayer laminating of the dielectric film with which refractive indexes differ as a polarization separation means. Moreover, since light carries out incidence to the plane of incidence of a polarization separation means at about 70 degrees, the laminating of the dielectric film of a flat field can be carried out, it can produce simply, and thickness can also be adjusted with a sufficient precision by the spatter, vacuum evaporationo, DIPINGU, etc. [0019] If the incident angle of incident light is generally set to theta in the interface of the transparence medium of a refractive index N0, and the transparence medium of a refractive index N1 when light carries out incidence from N0 medium to N1 medium When the tangent of the incident angle theta is equal to N1/N0 (tan theta=N 1/N0), there is no reflective component of P polarization, the

reflected light turns into S polarization altogether, and it is known that the transmitted light is remaining S polarization and remaining P polarization. The angle of incidence theta at this time is called brewster's angle. The laminating of the medium by which refractive indexes differ can be carried out using this brewster's angle, the phase of each polarization can be controlled by controlling that laminating thickness by wavelength order, only P polarization can be penetrated, and a polarization separation means to reflect S polarization can be produced.

[0020] Moreover, a depolarization child is preferably prepared in the above-mentioned wedge-action-die transparent material. For example, if a phase contrast plate is formed in the rear face of a wedge-action-die transparent material as a depolarization child, S polarization reflected with the polarization separation means turns into elliptically polarized light (the linearly polarized light and the circular polarization of light are included) with a phase contrast plate, and carries out incidence to a polarization separation means again, only P polarization component penetrates, it will be reflected and S polarization component will return to a transparent material. By repeating this, outgoing radiation of almost all the light is changed and carried out to P polarization. Therefore, the high polarization lighting system of efficiency for light utilization can be attained.

[0021] Moreover, the hologram which changes the lens array sheet of a transparent material made to carry out outgoing radiation in the direction of a normal mostly, a prism sheet array, or an optical path as said optical-path conversion means for the light by which outgoing radiation was carried out in the direction of slant, and has dispersion nature is used.

[0022] The liquid crystal display using the above-mentioned lighting system is considered as the configuration which set the polarization shaft of the incidence side polarizing plate of the liquid crystal display component which displays by controlling polarization conditions, such as TN mold and a STN mold, and the polarization shaft of a lighting system. Thereby, the light from a lighting system can be used efficiently and the liquid crystal display of a low power can be obtained brightly.

[0023] The liquid crystal display using the above-mentioned lighting system is considered as the configuration which prepared the light-scattering layer in one of the front flesh sides of a liquid crystal display component. Here, although it is desirable to arrange on the outside of the polarizing plate by the side of the screen as for a light-scattering layer, if a polarization condition is not changed, it will be satisfactory even if it arranges to the inside [of a polarizing plate], and lighting-system side of a liquid crystal display component. Furthermore, if the light-scattering layer is a layer which can control dispersion nature, according to a service condition, an angle of visibility can be adjusted to arbitration. Therefore, the liquid crystal display of a bright low power can be offered on a wide-field-of-view square.

[0024]

[Example]

[Example 1] The example of the lighting system of this invention and the liquid crystal display using it is explained to a detail using a drawing.

[0025] Drawing 1 is the type section Fig. of an example of the lighting system of this invention. The pattern of a white ink dot be form , and drawing 1 consist of transparent acrylic resin (refractive index 1.49) with which the thickness become thin as it separate from an end face , as it equip an end face with the cold cathode fluorescent lamp 10 which be an edge light flat-surface mold lighting system , and have the luminescence length corresponding to the die length of the side face of the wedge-action-die transparent material 30 , and the reflecting plate 11 for lamps which cover it and reflect light in a wedge-action-die transparent material side and keep away from a cold cathode fluorescent lamp in a rear face .

[0026] The pattern of the above-mentioned white ink dot can make outgoing radiation light from the wedge-action-die transparent material 30 the homogeneity within a field by carrying out printing formation so that dot area may become large as it separates from the cold cathode fluorescent lamp 10.

[0027] Moreover, a reflecting plate 31 and the depolarization child 32 are formed in the rear face of this wedge-action-die transparent material 30.

[0028] And the polarization separation means 40 which consists of dielectric multilayers on this wedge-action-die transparent material 30 is arranged. Furthermore, on it, a prism array sheet is arranged as an

optical-path conversion means 50, and the vertical angle 51 is made into 65 degrees so that incident light may carry out incidence to the light-scattering object 60 almost perpendicularly. On it as a light-scattering object 60 "A Novel Polmer Film that Contorols Light Transmission"Progress in Pacific Polymer Sience 3 Springer-Verlag Berlin Heidelberg 1994 The polymer film of a publication was used [159-169-page].

[0029] In addition, it is set up with directivity and an optical-path conversion include angle to which a vertical-angle [of a prism array sheet] and vertical-angle side is turned, and a vertical angle is not limited to 65 degrees, either.

[0030] Moreover, as the outgoing radiation light distribution from this wedge-action-die transparent material 30 is shown in drawing 7 , maximum is shown in a direction about 70 degrees to the outgoing radiation side normal of the wedge-action-die transparent material 30. the half-value width at that time is **10 or less degrees, and that parallelism is quite high turned out to come out of. Therefore, the property of the polarization separation means 40 which consists of big dielectric multilayers of angular dependence is effectively utilizable.

[0031] If such a polarization separation means 40 is arranged on the wedge-action-die transparent material 30, as shown in drawing 2 , the light 100 which carried out the light guide of the wedge-action-die transparent material 30 will serve as the path 101 of light, and will carry out outgoing radiation from a wedge-action-die transparent material, and only P polarization component will carry out outgoing radiation as a path 102,103 of light.

[0032] On the other hand, it is reflected in respect of each field, and S polarization component serves as the path 104 of light, and incidence is carried out into a wedge-action-die transparent material, and it is changed into P polarization by the depolarization child 32 stationed at the rear face, it becomes the path 106,107 of light, and outgoing radiation only of the P polarization component is carried out.

[0033] Since the depolarization child 32 exists in the rear face of the wedge-action-die transparent material 30, S polarization is changed into P polarization. Even if changed into elliptically polarized light, only P polarization component of them penetrates the polarization separation means 40, and S polarization component is reflected. This will be repeated, and, finally outgoing radiation of all the light will be changed and carried out to P polarization.

[0034] In this example, the polarization separation means which consists of dielectric multilayers shown in drawing 10 as a polarization separation means 40 was used. The polycarbonate (refractive index 1.586) was used for the support medium 43, MgF2 (refractive index 1.38) was used for ZrO2 (refractive index 2.05) and the transparence medium 42 at the transparence medium 41, and the five-layer laminating of the transparence media 41 and 42 was carried out by turns.

[0035] The thickness at this time set the transparence media 41 and 42 to 138nm, and set the tilt angle 45 of the lower support medium 43 as about 8 times. The light by which is because outgoing radiation of the outgoing radiation light from the wedge-action-die transparent material 30 was carried out by about 70, and outgoing radiation was carried out at 70 degrees is the interface of above-mentioned each class, and this was set up so that said Brewster conditions might be fulfilled. However, if the refractive index of a transparence medium or a support medium changes, it will set up according to it.

[0036] S when carrying out incidence of the non-polarized light to the polarization separation means shown in drawing 10 at 70 degrees and the spectral transmittance of P car polarization are shown in drawing 11 . Although P polarization shows high permeability in all visible regions (440-700nm) mostly, S polarization has low permeability in all visible regions. That is, almost all light was reflected and the good polarization separation means was able to be formed.

[0037] It was adapted for the lighting system of drawing 1 in this polarization separation means, and when the polarization shaft of a TFT-liquid-crystal display device was set and carried, the thing of one about 1.5 times [at the time of making power consumption of a back light the same, and using the conventional lighting system] the brightness of this was able to be obtained.

[0038] Next, the phase contrast plate has been arranged as a depolarization child 32 on the wedge-action-die transparent material 30 as shown in drawing 3 , and others were made the same as drawing 1 . Also in this case, the lighting system with high degree of polarization was able to be obtained like the

above. When the polarization shaft of a TFT mold liquid crystal display component was set and this was carried, the thing of one about 1.5 times the brightness of this was able to be obtained like the above.
[0039] Next, as shown in drawing 4 , it considered as the configuration which has arranged the hologram as the optical-path conversion means 50 of drawing 1 , and an optical-path conversion means (optical-path conversion means of dispersion nature) 70 to have dispersion nature and directivity instead of the light-scattering object 60.
[0040] As the above-mentioned hologram is shown in drawing 8 and the mimetic diagram of 9, it is produced. The parallel reference beam 151 and the body light 150 were irradiated at the phot polymer 71 (DMP-128), using laser as the good light source of coherence. The diffraction grating by which the refractive index was modulated by interference of a reference beam 151 and the body light 150 on the phot polymer 71 is formed.
[0041] In this way, if incident light 153 is irradiated from the same direction with a reference beam 151 at the optical-path conversion means 70 of the produced hologram, according to the hologram effectiveness, it will diffract and outgoing radiation will be carried out in the direction of the outgoing radiation light 152. Thereby, optical-path conversion can be attained efficiently.
[0042] Moreover, a hologram is obtained by carrying out incidence of the body light 154 which condensed as a body light as shown in drawing 9 , and producing it like the above to obtain the light of diffusibility. If incidence of the incident light 153 is carried out to the optical-path conversion means 70 of this hologram from the same direction as a reference beam 151, the outgoing radiation light 155 diffused according to the hologram effectiveness will be obtained.
[0043] Thus, by adjusting the diffusion condition of body light, a hologram with the diffusibility of arbitration can be produced, and the outgoing radiation light from the polarization separation means 40 can be changed or diffused in the direction of a normal of a wedge-action-die transparent material outgoing radiation side.
[0044] The TFT mold liquid crystal display component 200 equipped with the active component using TN liquid crystal which displays by controlling polarization on the above-mentioned lighting system as shown in drawing 5 has been arranged. By making the polarization direction of the polarization shaft of the polarizing plate of the liquid crystal display component 200, and a lighting system mostly in agreement, the liquid crystal display equipped with one about 1.5 times [when brightness uses the conventional lighting system] the high angle-of-visibility property of this was able to be obtained.
[0045] Moreover, the TFT mold liquid crystal display component 200 equipped with the active component using TN liquid crystal which displays by controlling polarization on the above-mentioned lighting system as shown in drawing 6 has been arranged. The polarization direction of the polarization shaft of the polarizing plate of a liquid crystal display component and a lighting system was made mostly in agreement. The directive high hologram shown in drawing 8 as an optical-path conversion means 70 was used for the lighting system at this time, and it has arranged the light-scattering object to the screen side of the liquid crystal display component 200.
[0046] In addition, if a light-scattering object does not break down polarization in this case, it will not be limited in which location of a liquid crystal display it arranges. However, since permeability and a contrast ratio will become higher if a liquid crystal display component side is penetrated perpendicularly, it is effective to arrange a light-scattering object to the screen side of a liquid crystal display component in a lighting system with large directivity.
[0047] As mentioned above, you change the outgoing radiation light from a lighting system almost perpendicularly to the screen of a liquid crystal display component with an optical-path conversion means, you make it scattered about after liquid crystal display component transparency, and there are a configuration which extends an angle of visibility, and a configuration which polarization is maintained and scattered over the incident light of a liquid crystal display component, and extends an angle-of-visibility property.
[0048] In the case of the former, it is necessary to raise the parallelism of the outgoing radiation light from a lighting system so that dotage between pixels may not arise. Moreover, in the case of the latter, it is effective to use a liquid crystal display component with a sufficient angle-of-visibility property.

[0049] As a liquid crystal display component with a sufficient angle-of-visibility property, there are a TN liquid crystal component of a multi-domain and a random domain and a TN liquid crystal component of the horizontal electric-field method which impresses an electrical potential difference parallel to the screen, and controls the orientation condition of a liquid crystal layer.
[0050] Moreover, as shown in drawing 1 and 3, in order to penetrate P polarization efficiently with a polarization separation means and to change reflected S polarization into P polarization efficiently, it is desirable to station the depolarization child 32. Although it is desirable that the phase contrast of a round trip is 1/2 of wavelength as S polarization is changed into P polarization as a depolarization child 32, only what was changed into P polarization penetrates a polarization separation means, S polarization repeats reflection, and since outgoing radiation is changed and carried out to P polarization finally [all], especially phase contrast is not limited.
[0051] In addition, although the phase contrast film which extended the polycarbonate etc. can be used as a depolarization child 32, especially if it has the same property, it will not be limited to this.
[0052] In this example, although acrylic resin was used as a wedge-action-die transparent material, transparence media, such as glass, a polycarbonate, polyurethane, polystyrene, and silicone, can be used.

[0053] As a polarization separation means, although the multilayers of ZrO2 and MgF2 were used on the polycarbonate base material, germanium, Y2O3, ZnO, Si, ZnS, TiO2 and SiO2, and Ta2O5 grade can be used in addition to the above, and it is not limited to these further again.
[0054] [Example 2] In order to reduce the reflection in the interface of the optical-path conversion means 50 and the light-scattering object 60 in drawing 1 , it is the Dupont-Mitsui Fluorochemicals make. TEFLON AF Reflection is reduced and said wedge-action-die lighting system which pasted up 1600 (refractive index 1.31) film and was made to intervene can improve brightness more.
[0055] Like [the top face of the optical-path conversion means 70 of drawing 4] the top face of the optical-path conversion means 50 of drawing 3 , it is TEFLON. AF Said each of wedge-action-die lighting systems which pasted up 1600 (refractive index 1.31) film and was made to intervene could reduce reflection, and its brightness increased about 5%.
[0056] It sets to drawing 5 and is TEFLON between the liquid crystal display component 200 and the light-scattering object 60 and between the light-scattering object 60 and the optical-path conversion means 50. AF The liquid crystal display whose brightness improved like the above by pasting up and making 1600 (refractive index 1.31) film intervene was obtained. If a low refractive-index medium was arranged between the optical-path conversion means 50 and the polarization eliminator 40 at this time, since the outgoing radiation angle from the polarization eliminator 40 would become small, the vertical angle 51 is made still smaller and was made to carry out incidence almost at right angles to the light-scattering object 60.
[0057] Moreover, it sets to drawing 6 and is TEFLON between the liquid crystal display component 200 and the optical-path conversion means 70 and between the optical-path conversion means 70 and the polarization separator 40. AF Even if it had arranged 1600 film, brightness improved similarly. Since the outgoing radiation angle from the polarization eliminator 40 changes at this time (an outgoing radiation angle will become small if a low refractive-index transparence medium is made to intervene), it is TEFLON. AF It is necessary to produce the optical-path conversion means 70 on the assumption that 1600 film makes it intervene.
[0058] A bright lighting system can be obtained with a low power with high degree of polarization by considering as a configuration like examples 1 and 2 above. Furthermore, by applying to the TFT mold liquid crystal display of an active drive using TN liquid crystal which displays on such a lighting system by controlling polarization, and the STN mold liquid crystal display of a passive-matrix drive using TN liquid crystal, it is bright and the liquid crystal display of a low power can be offered.
[0059]
[Effect of the Invention] the polarization eliminator which is large as for the outgoing radiation include angle of the outgoing radiation light of the lighting system using the wedge-action-die transparent material of this invention, and consists of flat multilayers -- low cost -- production -- an easy lighting

system can be offered. Moreover, the bright high liquid crystal display of a contrast ratio can be offered by establishing an optical-path conversion means so that incidence of the polarization of the slanting outgoing radiation of the wedge-action-die transparent material of this invention may be carried out almost at right angles to a liquid crystal display component.

[0060] By making a low refractive-index transparence medium intervene between each configuration layer of the wedge-action-die transparent material of this invention, reflection between each configuration layer can be reduced and a brighter lighting system is obtained further again.

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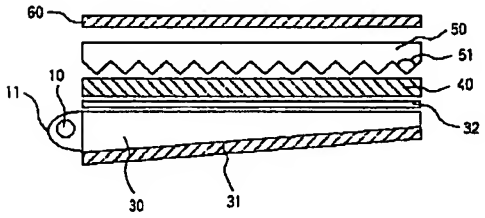
DRAWINGS

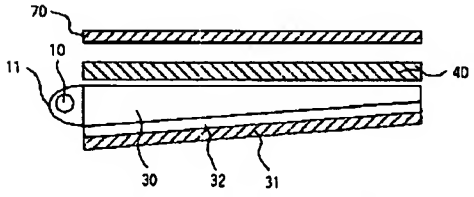
[Drawing 3]

図 3



[Drawing 4]

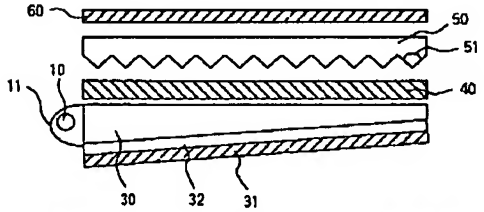
図 4



７０…光路変換手段（散乱性の光路変換手段）

[Drawing 1]

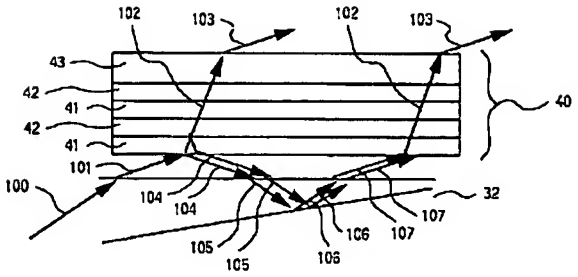
図 1



１０…冷陰極蛍光ランプ　１１…ランプ用反射板　３０…板型導光体
３１…反射板　３２…偏光解消子　４０…偏光分離器　５０…光路変換手段
５１…頂角　６０…光散乱体

[Drawing 2]

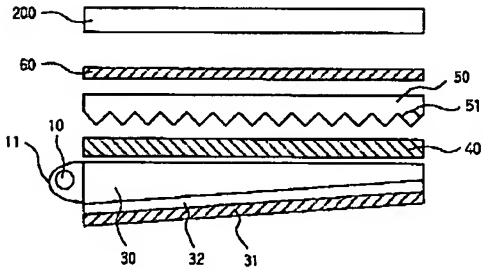
図 2



４１，４２…透明媒体　４３…支持体　１００～１０７…光の経路

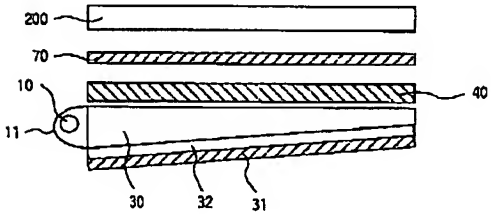
[Drawing 5]

図 5



[Drawing 6]

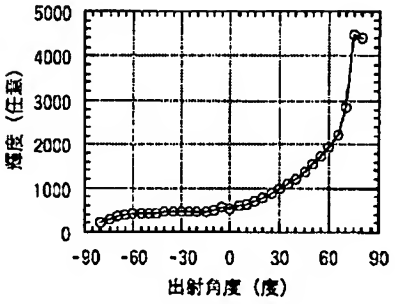
図 6



２００…液晶表示素子

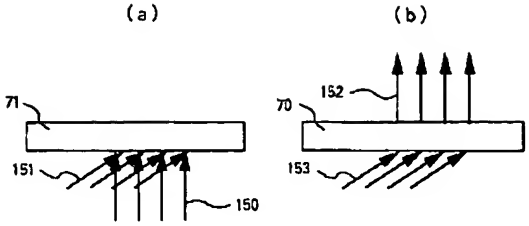
[Drawing 7]

図 7



[Drawing 8]

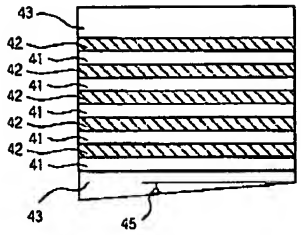
図 8



７１…ホトポリマ １５０…分体光 １５１…参照光 １５２…出射光
１５３…入射光

[Drawing 10]

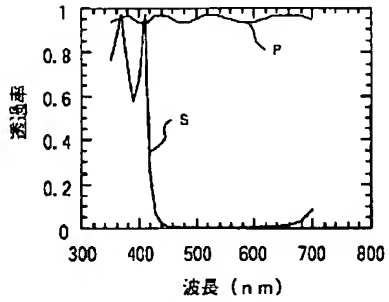
図 １０



４５…傾斜角

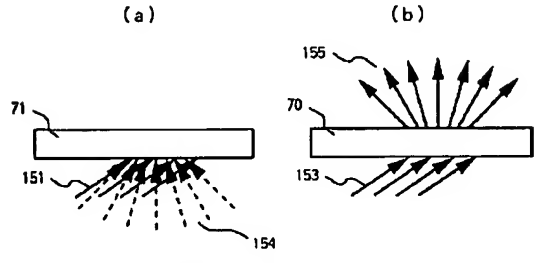
[Drawing 11]

図 １１



[Drawing 9]

図 9



１５４…集光した物体光 １５５…拡散した出射光

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平9－146092

(43)公開日　平成９年(1997)６月６日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ			技術表示箇所
Ｇ０２Ｆ	1/1335	５３０		Ｇ０２Ｆ	1/1335	５３０	
Ｆ２１Ｖ	8/00	６０１		Ｆ２１Ｖ	8/00	６０１Ａ	
Ｇ０９Ｆ	9/00	３３２		Ｇ０９Ｆ	9/00	３３２Ｆ	
		３３６				３３６Ｊ	

審査請求　未請求　請求項の数17　ＯＬ　（全８頁）

(21)出願番号　特願平7－304518

(22)出願日　平成７年(1995)11月22日

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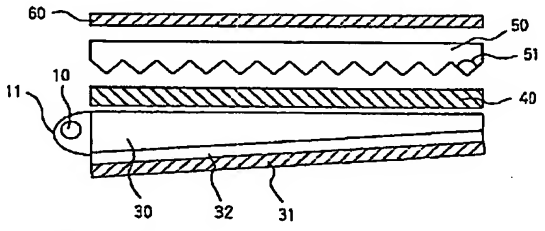
(54)【発明の名称】　照明装置およびそれを用いた液晶表示装置

(57)【要約】

【課題】平坦な誘電体多層膜からなり、作製が容易で低コストの偏光分離器を用いて、光の吸収損失の少なく高偏光度で、光の均一性が高い照明装置を提供することにある。

【解決手段】光源と該光源に近接配置された楔型導光体からなる照明装置であって、楔型導光体からの出射光の指向性が大きく、楔型導光体の出射側に偏光分離器を、該偏光分離器上に光路変換手段を有する照明装置。

図　1



１０…冷陰極蛍光ランプ　１１…ランプ用反射板　３０…楔型導光体
３１…反射板　３２…偏光解消子　４０…偏光分離器　５０…光路変換手段
５１…頂角　６０…光散乱体

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【特許請求の範囲】

【請求項１】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体の厚さが前記光源から離れるに従い薄くなるように形成され、かつ、導光体からの出射光の指向性が大きく、該導光体の出射側に偏光分離手段、該偏光分離手段上に光路変換手段を備えたことを特徴とする照明装置。

【請求項２】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光路変換手段を備えたことを特徴とする照明装置。

【請求項３】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光を導光体の出射面のほぼ法線方向に出射する光路変換手段を備えたことを特徴とする照明装置。

【請求項４】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光を導光体の出射面のほぼ法線方向に光強度の最大値を持ち、散乱性の光に変換，出射する光路変換手段を備えたことを特徴とする照明装置。

【請求項５】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光を導光体の出射面のほぼ法線方向に出射する光路変換手段を有し、該光路変換手段上に偏光能と散乱性とを有する光散乱体を備えたことを特徴とする照明装置。

【請求項６】　前記光路変換手段が散乱性と指向性とを有するホログラムである請求項５に記載の照明装置。

【請求項７】　前記偏光分離手段が屈折率の異なる平坦な多層膜で構成されている請求項１～６のいずれかに記載の照明装置。

【請求項８】　前記導体上の偏光分離手段または光路変換手段に、これらの屈折率よりも低屈折率の透明媒体が配設されている請求項１～７のいずれかに記載の照明装置。

【請求項９】　一対の偏光板を備え光の偏光状態を制御することにより画像表示する液晶表示装置であって、光源と該光源に近接配置された導光体を備え、前記導光体の厚さが前記光源から離れるに従い薄くなるように形成され、かつ、導光体からの出射光の指向性が大きく、該導光体の出射側に偏光分離手段、該偏光分離手段上に光路変換手段を備えた照明装置を液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【請求項１０】　一対の偏光板を備え光の偏光状態を制御することにより画像表示するた液晶表示装置であって、

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光源と該光源に近接配置された導光体を備え、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光路変換手段を備えた照明装置を液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【請求項１１】　一対の偏光板を備え光の偏光状態を制御することにより画像表示するた液晶表示装置であって、

光源と該光源に近接配置された導光体を備え、該導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光を導光体の出射面のほぼ法線方向に出射する光路変換手段を備えた照明装置を液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【請求項１２】　光源と該光源に近接配置された導光体を備えた照明装置であって、前記導光体が光源から離れるに従い薄くなる楔型導光体で、該楔型導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光を導光体の出射面のほぼ法線方向に光強度の最大値を持ち、散乱性の光に変換，出射する光路変換手段を備えた照明装置を液晶表示素子の背面に配置したことを特徴とする液晶表示装置。

【請求項１３】　前記照明装置の偏光分離手段が屈折率の異なる平坦な多層膜で構成されている請求項８～１２のいずれかに記載の液晶表示装置。

【請求項１４】　前記液晶表示素子の表面側に光散乱層が配置されている請求項８～１３のいずれかに記載の液晶表示装置。

【請求項１５】　前記液晶表示素子の一対の偏光板間に光散乱性を有する光散乱層が配置されている請求項８～１４のいずれかに記載の液晶表示装置。

【請求項１６】　前記照明装置の導体上の偏光分離手段または光路変換手段に、これらの屈折率よりも低屈折率の透明媒体が配設されている請求項８～１５のいずれかに記載の液晶表示装置。

【請求項１７】　前記照明装置の出射光の平均的な偏光軸と、液晶表示素子の光入射側偏光板の偏光軸とがほぼ一致するよう構成された照明装置が、液晶表示素子の背面に配置されている請求項８～１６のいずれかに記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、液晶テレビ、コンピュータ用液晶ディスプレイ等に用いられる、直線偏光入射光の偏光状態を変調する平面状照明装置に係り、特に、偏光制御した平面状照明装置とそれを用いた直視型液晶表示装置に関する。

【０００２】

【従来の技術】近年、液晶表示装置、特にカラー液晶表示装置の技術進歩は目覚ましく、ＣＲＴに劣らぬ表示品質のディスプレイが見られるようになった。さらに、ノート型パーソナルコンピュータの普及に伴い、バックライト（照明装置）無しではディスプレイとしての態をなさず、バックライトは直視型カラー液晶表示装置における必須デバイスである。

【０００３】こうしたカラー液晶表示装置は、大別してＴＦＴ（薄膜トランジスタ）を用いたアクティブマトリクス駆動によるＴＮ（ツイストネマチック）液晶表示装置と、マルチプレックス駆動によるＳＴＮ（スーパーツイステッドネマチック）液晶表示装置との２方式がある。いずれも液晶層をガラス基板で保持した素子の両側に偏光板を配置し、直線偏光入射光の偏光状態を変調して表示を行うものである。

【０００４】これらのバックライトに要求される輝度レベルはその用途によって様々であるが、特に、カラーノート型パーソナルコンピュータでは輝度の他に薄型、軽量、低消費電力が重要な課題である。

【０００５】しかし、従来、液晶表示素子の裏面に配置したバックライトからの出射光は無偏光であるため、ＴＮ型およびＳＴＮ型いずれの液晶表示素子の場合も、表示素子の光入射側に配置された偏光板により入射光の半分以上が吸収されてしまい、光利用効率が低く、暗い表示となる。これを明るくするためにバックライトの輝度を増すと、電力消費量が増加してしまうと云う問題があった。

【０００６】

【発明が解決しようとする課題】前記課題を解決するために、例えば、特開平６－２６５８９２号公報のように面上導光体の光出射面側に、出射光が面上導光体表面に対しほぼ直角になるよな光偏向手段を設け、さらにその上に、断面が三角形状の柱状プリズムアレイのアレイ部分に、偏光分離層を積層した偏光分離手段を配置して偏光を出射する照明装置が提案されている。

【０００７】しかし、高い偏光度を有する高性能な偏光照明装置を達成するには、偏光分離層への入射光に高い平行度が要求される。そこで、こうした問題を解決するために、薄い導光パイプを隣接させ、かつ、マイクロプリズム構造により効率良く、高平行度の光を出射させる照明装置が特開平６－２０２１０７号公報に提案されている。しかし、微細な凹凸のプリズム面上に膜厚精度の要求が厳しい誘電体多層膜を積層するのは容易でなく、コストの上からも高いものになる。

【０００８】さらに、光源光の高い平行度と、面内の均一性を同時に達成するのは非常に困難であり、特に、こうした面内均一性に関するものはこれまで見当らない。

【０００９】本発明の目的は、平坦な誘電体多層膜からなり、作製が容易で低コストの偏光分離手段を用いて、光の吸収損失の少なく高偏光度で、光の均一性が高い照明装置を提供することにある。

【００１０】本発明の他の目的は、上記照明装置を用いた液晶表示装置を提供することにある。

【００１１】

【課題を解決するための手段】上記目的を達成する本発明の要旨は次のとおりである。

【００１２】光源と該光源に近接配置された導光体からなる照明装置であって、前記導光体が光源から離れるに従いその厚さが薄くなるように形成され、前記導光体の出射側に偏光分離手段を備え、該偏光分離手段上に光路を変換し導光体の出射面のほぼ法線方向に出射する光路変換手段を有する照明装置にある。

【００１３】また、上記の照明装置の出射光の平均的な偏光軸と、液晶表示素子における光入射側の偏光板の偏光軸とがほぼ一致するよう液晶表示素子の背面に前記照明装置を配置した液晶表示装置にある。

【００１４】

【発明の実施の形態】上記において、光源から離れるに従いその厚さが薄くなるように形成された導光体を楔型導光体と呼ぶ。この楔型導光体からの出射光は指向性の強いものであり、導光体の出射面の法線方向に対し約７０度の方向に出射され、半値幅（光強度が最大値の１／２になる角度範囲）±１０度以下で、かなり平行度の高いものである。

【００１５】誘電体多層膜からなる偏光分離手段を使用する場合、光源の平行度が要求されるが、この楔型導光体からの出射光はかなり平行度の高いものとなる。

【００１６】前記導光体の裏面に白色インクドットをランプから離れるに従ってドット面積を大きくして形成することより、面内の光の均一性を保つことができる。

【００１７】また、偏光分離手段として、前記導光体からの無偏光の出射光のうち、Ｐ偏光のみを透過し、Ｓ偏光を反射するように形成されている。ここで、Ｓ偏光は入射面（入射光線と境界面に立てた入射法線とがなす平面）に垂直な偏光であり、Ｐ偏光は上記入射面に平行な偏光である。

【００１８】偏光分離手段としては、屈折率の異なる誘電体膜を多層積層した誘電体多層膜である。また、偏光分離手段の入射面に約７０度で光が入射するため、平坦な面の誘電体膜を積層し簡易に作製でき、スパッタ、蒸着、ディピング等で膜厚も精度良く調節できる。

【００１９】一般に、屈折率N_0の透明媒体と屈折率N_1の透明媒体との界面において、N_0媒体からN_1媒体へ光が入射するとき入射光の入射角をθとすると、入射角θの正接がN_1/N_0に等しい（$\tan\theta=N_1/N_0$）とき、Ｐ偏光の反射成分は無く、全て反射光はＳ偏光となり、透過光は残りのＳ偏光とＰ偏光であることが知られている。このときの入射角θをブリュースタ角という。このブリュースタ角を利用して、屈折率の異なる媒体を積層し、その積層膜厚を波長オーダーで制御することで各偏

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光の位相を制御し、P偏光のみを透過し、S偏光を反射する偏光分離手段を作製することができる。

【0020】また、好ましくは、上記楔型導光体に偏光解消子を設ける。例えば、楔型導光体の裏面に偏光解消子として位相差板を設けると、偏光分離手段で反射されたS偏光は、位相差板により楕円偏光（直線偏光、円偏光を含む）となり、再び偏光分離手段に入射しP偏光成分のみが透過して、S偏光成分は反射され導光体へ戻る。これを繰り返すことにより、殆ど全ての光がP偏光に変換され出射される。従って、光利用効率の高い偏光照明装置を達成することができる。

【0021】また、前記光路変換手段としては、斜め方向に出射された光を導光体のほぼ法線方向に出射させるレンズアレイシート、プリズムシートアレイ、あるいは、光路を変換し、かつ、散乱性を有するホログラム等を用いる。

【0022】上記照明装置を用いた液晶表示装置は、TN型、STN型等偏光状態を制御して表示を行う液晶表示素子の入射側偏光板の偏光軸と、照明装置の偏光軸とを合わせた構成とする。これにより、照明装置からの光を効率良く利用でき、明るく低消費電力の液晶表示装置を得ることができる。

【0023】上記照明装置を用いた液晶表示装置は、液晶表示素子の表裏いずれか一方に光散乱層を設けた構成とする。ここで、光散乱層は表示面側の偏光板の外側に配置するのが好ましいが、偏光状態を変えるものでなければ、偏光板の内側、液晶表示素子の照明装置側に配置しても問題はない。さらに、その光散乱層が散乱性を制御できる層であれば、使用条件に応じて任意に視野角を調整できる。従って、広視野角で明るい低消費電力の液晶表示装置を提供することができる。

【0024】

【実施例】

〔実施例　1〕本発明の照明装置、およびそれを用いた液晶表示装置の実施例を図面を用いて詳細に説明する。

【0025】図1は、本発明の照明装置の一例の模式断面図である。図1はエッジライト平面型照明装置で、楔型導光体30の側面の長さに対応した発光長を有する冷陰極蛍光ランプ10と、それをカバーし光を楔型導光体側に反射するランプ用反射板11とを端面に備え、裏面には冷陰極蛍光ランプから遠ざかるにつれ、白色インクドットのパターンが形成され、端面から離れるに従いその厚さが薄くなる透明なアクリル樹脂（屈折率1.49）で構成されている。

【0026】上記の白色インクドットのパターンは、冷陰極蛍光ランプ10から離れるに従いドット面積が大きくなるよう印刷形成することにより、楔型導光体30からの出射光を面内均一にすることができる。

【0027】また、この楔型導光体30の裏面には、反射板31と偏光解消子32とを設ける。

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【0028】そしてこの楔型導光体30上に、誘電体多層膜からなる偏光分離手段40を配置し、さらにその上に、光路変換手段50としてプリズムアレイシートを配置し、光散乱体60に入射光がほぼ垂直に入射するようその頂角51を65度とし、その上には光散乱体60として、“A Novel Polmer Film that Contorols Light Transmission” Progress in Pacific Polymer Sience 3　Springer－Verlag Berlin Heidelberg　1994　159～169頁に記載のポリマーフィルムを使用した。

【0029】なお、プリズムアレイシートの頂角および頂角側をどちらに向けるかは指向性、光路変換角度により設定され、頂角も65度に限定されない。

【0030】また、この楔型導光体30からの出射光分布は図7に示すように、楔型導光体30の出射面法線に対して約70度方向に最大値を示す。その時の半値幅は±10度以下で、かなり平行度の高いものでることが分かった。従って、角度依存性の大きな誘電体多層膜からなる偏光分離手段40の特性を有効に活用することができる。

【0031】このような偏光分離手段40を楔型導光体30の上に配置すると、図2に示すように、楔型導光体30を導光した光100は、光の経路101となって楔型導光体から出射しP偏光成分のみが光の経路102，103として出射する。

【0032】一方、S偏光成分は各界面で反射されて光の経路104となり楔型導光体内に入射し、裏面に配置された偏光解消子32によりP偏光に変換され、光の経路106，107となってP偏光成分のみが出射される。

【0033】楔型導光体30の裏面に偏光解消子32が存在するためにS偏光がP偏光に変換される。楕円偏光に変換されてもその内のP偏光成分のみが偏光分離手段40を透過し、S偏光成分は反射される。これを繰り返し、最終的には全ての光がP偏光に変換されて出射されることになる。

【0034】本実施例では、偏光分離手段40として図10に示す誘電体多層膜からなる偏光分離手段を用いた。支持媒体43にポリカーボネート（屈折率1.586）、透明媒体41にZrO_2（屈折率2.05）、透明媒体42にはMgF_2（屈折率1.38）を用い、透明媒体41、42を交互に5層積層した。

【0035】この時の膜厚は透明媒体41、42共に138nmとし、下側の支持媒体43の傾斜角45を約8度に設定した。これは、楔型導光体30からの出射光が約70で出射されるようにしたためで、70度で出射された光が上記各層の界面で、前記ブリュースタ条件を満たすように設定した。しかし、透明媒体や支持媒体の屈折率が変われば、それに合わせて設定する。

【0036】図10に示す偏光分離手段に70度で無偏

光の光を入射したときのＳ、Ｐ両偏光の分光透過率を図１１に示す。Ｐ偏光はほぼ全可視域（４４０～７００ｎｍ）において高い透過率を示しているが、Ｓ偏光は全可視域で透過率が低い。即ち、ほとんどの光が反射され、良好な偏光分離手段を形成することができた。

【００３７】この偏光分離手段を図１の照明装置に適応し、ＴＦＴ液晶表示素子の偏光軸を合わせて搭載したところ、バックライトの消費電力を同じにして従来の照明装置を用いた場合の約１．５倍の明るさのものを得ることができた。

【００３８】次に、図３に示すような楔型導光体３０の上に偏光解消子３２として位相差板を配置し、その他は図１と同じにした。この場合も、上記と同様に偏光度の高い照明装置を得ることができた。これをＴＦＴ型液晶表示素子の偏光軸を合わせて搭載したところ、上記と同様に約１．５倍の明るさのものを得ることができた。

【００３９】次に、図４に示すように、図１の光路変換手段５０と光散乱体６０の代わりに、散乱性と指向性を有する光路変換手段（散乱性の光路変換手段）７０としてホログラムを配置した構成とした。

【００４０】上記のホログラムは、図８，９の模式図に示すようにして作製される。干渉性の良い光源としてレーザを用い、平行な参照光１５１と物体光１５０をホトポリマ７１（ＤＭＰ－１２８）に照射した。参照光１５１と物体光１５０の干渉によりホトポリマ７１上に屈折率が変調された回折格子が形成される。

【００４１】こうして作製されたホログラムの光路変換手段７０に参照光１５１と同じ方向から入射光１５３を照射すると、ホログラム効果により出射光１５２の方向に回折，出射する。これにより、効率良く光路変換を達成することができる。

【００４２】また、拡散性の光を得たい場合には、図９に示すように物体光として集光した物体光１５４を入射して上記と同様に作製することによりホログラムが得られる。このホログラムの光路変換手段７０に、参照光１５１と同一方向から入射光１５３を入射すると、ホログラム効果により拡散した出射光１５５が得られる。

【００４３】このように、物体光の拡散状態を調節することで、任意の拡散性を持つホログラムが作製でき、偏光分離手段４０からの出射光を楔型導光体出射面の法線方向に変換または拡散することができる。

【００４４】図５に示すように上記照明装置上に、偏光を制御し表示を行うＴＮ液晶を用いたアクティブ素子を備えたＴＦＴ型液晶表示素子２００を配置した。液晶表示素子２００の偏光板の偏光軸と照明装置の偏光方向をほぼ一致させることにより、明るさが従来の照明装置を用いた場合の約１．５倍の、高視野角特性も備えた液晶表示装置を得ることができた。

【００４５】また、図６に示すように上記照明装置上に、偏光を制御し表示を行うＴＮ液晶を用いたアクティブ素子を備えたＴＦＴ型液晶表示素子２００を配置した。液晶表示素子の偏光板の偏光軸と照明装置の偏光方向をほぼ一致させた。この時の照明装置は、光路変換手段７０として図８に示す指向性の高いホログラムを使用し、液晶表示素子２００の表示面側に光散乱体を配置した。

【００４６】なお、この場合、光散乱体が偏光を崩さないものであれば、液晶表示装置のどの位置に配置するかは限定されない。しかし、透過率、コントラスト比は、液晶表示素子面を垂直に透過するとより高くなるために、指向性が大きい照明装置では、光散乱体は液晶表示素子の表示面側に配置することが有効である。

【００４７】以上のように、照明装置からの出射光を光路変換手段により液晶表示素子の表示面に対してほぼ垂直に変換し、液晶表示素子透過後散乱させて、視野角を拡げる構成と、液晶表示素子の入射光に偏光を維持し散乱させて、視野角特性を拡げる構成がある。

【００４８】前者の場合は、画素間のぼけが生じないように照明装置からの出射光の平行度を高める必要がある。また、後者の場合は、視野角特性の良い液晶表示素子を用いるのが有効である。

【００４９】視野角特性の良い液晶表示素子として、マルチドメイン、ランダムドメインのＴＮ型液晶素子、表示面に平行な電圧を印加し液晶層の配向状態を制御する横電界方式のＴＮ型液晶素子がある。

【００５０】また、図１，３に示すように、偏光分離手段でＰ偏光を効率良く透過し、反射されたＳ偏光を効率良くＰ偏光に変換するため、偏光解消子３２を配置することが好ましい。偏光解消子３２としては、Ｓ偏光がＰ偏光に変換されるように往復の位相差が波長の１／２であることが好ましいが、Ｐ偏光に変換されたものだけ偏光分離手段を透過し、Ｓ偏光は反射を繰り返し、最終的には全てＰ偏光に変換され出射されるので位相差は特に限定されない。

【００５１】なお、偏光解消子３２としては、ポリカーボネート等を延伸した位相差フィルムを使用できるが、同じ特性を有するものであれば特にこれに限定されない。

【００５２】本実施例では、楔型導光体としてアクリル樹脂を用いたが、ガラス、ポリカーボネート、ポリウレタン、ポリスチレン、シリコーン等の透明媒体を使用することができる。

【００５３】さらにまた、偏光分離手段として、ポリカーボネート支持体上にZrO_2とMgF_2の多層膜を用いたが、上記以外にＧｅ、Y_2O_3、ＺｎＯ、Ｓｉ、ＺｎＳ、TiO_2、SiO_2、Ta_2O_5等を使用することができ、これらに限定されない。

【００５４】〔実施例　２〕図１において、光路変換手段５０と光散乱体６０との界面における反射を低減するために、三井・デュポンフロロケミカル製　ＴＥＦＬＯ

N AF 1600（屈折率1.31）膜を接着，介在させた前記楔型照明装置は、反射が低減され、より明るさを向上することができる。

【0055】図3の光路変換手段50の上面に、図4の光路変換手段70の上面に同様にTEFLON AF 1600（屈折率1.31）膜を接着，介在させた前記楔型照明装置は、いずれも反射を低減することができ、約5%明るさが増した。

【0056】図5において、液晶表示素子200と光散乱体60との間、および光散乱体60と光路変換手段50との間にTEFLON AF 1600（屈折率1.31）膜を接着，介在させることで、上記と同様に明るさが向上した液晶表示装置を得た。この時、光路変換手段50と偏光分離器40との間に低屈折率媒体を配置すると、偏光分離器40からの出射角が小さくなるため、頂角51を更に小さくして、光散乱体60にほぼ垂直に入射するようにした。

【0057】また、図6において、液晶表示素子200と光路変換手段70との間、および、光路変換手段70と偏光分離機40との間にTEFLON AF 1600膜を配置しても、同様に明るさが向上した。この時、偏光分離器40からの出射角が変わる（低屈折率透明媒体を介在させると出射角が小さくなる）ため、TEFLON AF 1600膜の介在させることを前提に、光路変換手段70を作製する必要がある。

【0058】以上実施例1、2のような構成とすることで、偏光度の高い低消費電力で明るい照明装置を得ることができる。さらには、このような照明装置に偏光を制御して表示を行うTN液晶を用いたアクティブ駆動のTFT型液晶表示装置、TN液晶を用いた単純マトリクス駆動のSTN型液晶表示装置に適用することにより、明るく、かつ、低消費電力の液晶表示装置を提供できる。

【0059】

【発明の効果】本発明の楔型導光体を用いた照明装置の出射光の出射角度は大きく、平坦な多層膜からなる偏光分離器により、低コストで作製容易な照明装置を提供することができる。また、本発明の楔型導光体の斜め出射の偏光を液晶表示素子にほぼ垂直に入射するよう光路変換手段を設けることで、明るくコントラスト比の高い液晶表示装置を提供することができる。

【0060】さらにまた、本発明の楔型導光体の各構成層の間に低屈折率透明媒体を介在させることで、各構成層間での反射を低減でき、より明るい照明装置が得られる。

【図面の簡単な説明】

【図1】本発明の照明装置の一実施例を示す模式断面図である。

【図2】本発明の照明装置の作用を示す模式断面図である。

【図3】本発明の照明装置の一実施例を示す模式断面図である。

【図4】本発明の照明装置の一実施例を示す模式断面図である。

【図5】本発明の照明装置を用いた液晶表示装置の一実施例を示す模式断面図である。

【図6】本発明の照明装置を用いた液晶表示装置の一実施例を示す模式断面図である。

【図7】本発明の照明装置の一実施例の特性図である。

【図8】本発明の照明装置に用いる光路変換手段の製法の一例を示す模式断面図である。

【図9】本発明の照明装置に用いる光路変換手段の製法の一例を示す模式断面図である。

【図10】本発明の誘電体多層膜からなる偏光分離器の模式断面図である。

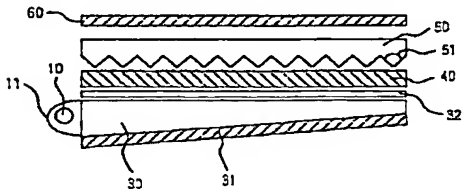
【図11】S、P両偏光の透過率と波長の関係を示す図である。

【符号の説明】

10…冷陰極蛍光ランプ、11…ランプ用反射板、30…楔型導光体、31…反射板、32…偏光解消子、40…偏光分離器、41,42…透明媒体、43…支持体、45…傾斜角、50…光路変換手段、51…頂角、60…光散乱体、70…光路変換手段（散乱性の光路変換手段）、71…ホトポリマ、100～107…光の経路、200…液晶表示素子、150…物体光、151…参照光、152…出射光、153…入射光、154…集光した物体光、155…拡散した出射光。

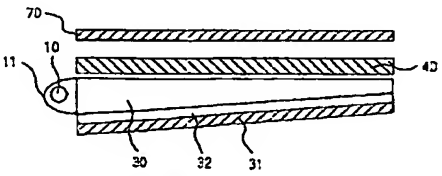
【図3】

図 3



【図4】

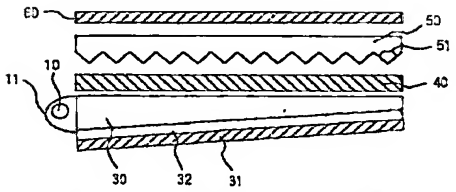
図 4



70…光路変換手段（散乱性の光路変換手段）

【図1】

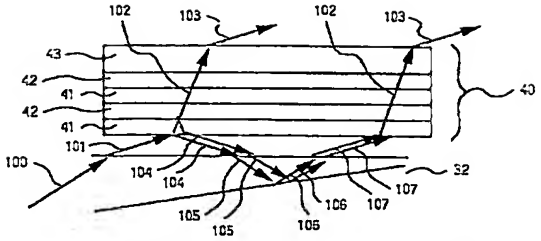
図　1



１０…冷陰極蛍光ランプ　１１…ランプ用反射板　３０…楔型導光体
３１…反射板　３２…偏光解消子　４０…偏光分離器　５０…光路変換手段
５１…頂角　６０…光散乱体

【図2】

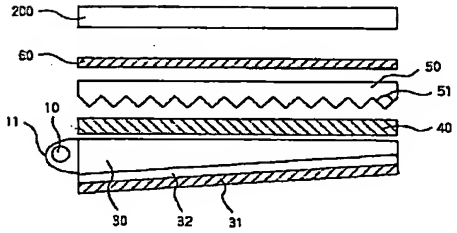
図　2



４１，４２…透明媒体　４３…支持体　１００～１０７…光の経路

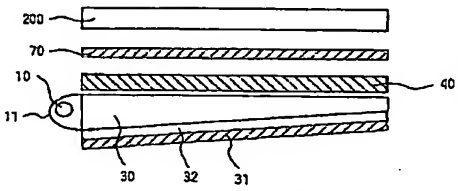
【図5】

図　5



【図6】

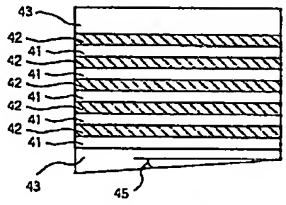
図　6



２００…液晶表示素子

【図10】

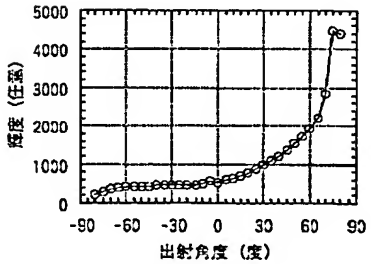
図　10



４５…傾斜角

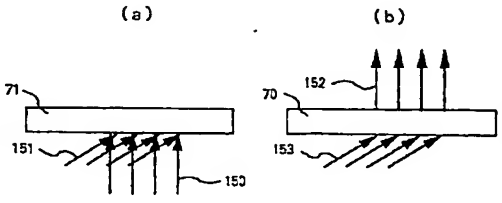
【図7】

図　7



【図8】

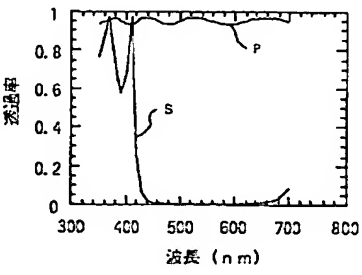
図　8



７１…ホトポリマ　１５０…分体光　１５１…参照光　１５２…出射光
１５３…入射光

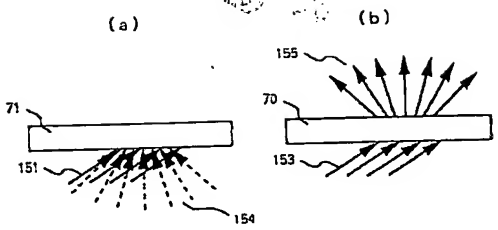
【図11】

図　11



【図9】

図 9



154…拡光した牡体光　155…拡散した出射光